Errors accumulate during procedures. That's the reason botching the access at the start of an RCT is so much more devastating than say, problems that come from misfitting a gutta-percha cone just before finishing the case. Miss a canal and the case is going down, regardless of how brilliant the remaining procedure is carried out. Perforate the tooth, and suddenly titanium starts looking better. Cut huge access cavities, and expect to see relatively huge numbers of root-fractured teeth within five years of treatment. Simply cheat the access procedure by beginning the instrumentation of canals before a straight, perfectly smooth path has been cut to each canal orifice, and be punished every time a file, an irrigating needle, an explorer, a gutta-percha point, a paper point or a plugger is taken into each of the canals scores of times.

This is not a critique so much as an admission of the ways that teeth and their root canal systems have taught me, usually the hard way, to spend whatever time is needed to create perfect entry paths into canals, before I attempt to work in them. So why do I have to have a talk with myself before beginning every access cavity—even after doing this for 35 years—to be certain to hit the mark I know must be met before it is safe to venture further?

Zen and the art of endo access

Robert Persig, in his book "Zen and the Art of Motorcycle Maintenance," described being deeply frustrated when a bolt stripped as he was attempting to remove the side covers to the engine of his motorcycle, before rebuilding it. The rebuild could not continue until he was able to circumvent this problem. He had expected to spend several days completing the mission, yet he was amazed at the fury he experienced when faced with this conundrum.

The more he thought about it, the more mystified he became about his instinctual response, until he realized that he was tweaked because he had grossly undervalued this part of the long rebuild procedure, thinking mostly about the more dramatic routines to follow, such as cracking the cylinder case, honing the cylinder, replacing the piston and putting it all back together afterward. When he realized that nothing was going to progress until he had successfully removed the side cover, he made removing that side cover a separate and important mission, an accomplishment that would deliver satisfaction in and of itself, if it could be completed during the next several hours spent.
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So it is with endodontics. When we realize how critical the quality of our access preparations is to the remainder of the case, it feels like fingernails on a chalkboard to head into a canal before securing an ideal path into it. Aristotle got it right—excellence is a habit, not a character trait. So what do the habits of access excellence look like in this 21st-century?

Failing to plan is planning to fail

Atul Gawande, in his book "The Checklist Manifesto," describes the importance of planning not just which procedure to do, but how every single aspect of that procedure must be planned in detail, from start to finish, if consistently ideal results are the goal. Does the preoperative imaging accurately describe the anatomical challenges? Does the clinician have adequate magnification and light? Are the cutting tools adequate and well chosen? Are the locations, angles and depths of entry determined before beginning the procedure? Have maximal safe cutting lengths been marked on access burs? Are there procedures in place to deal with calcified canals that defy location? And so on.

In my practice, a mesial off-angle view of anteriors and premolars works well, because it is much easier to capture than a distal angle, and in anteriors and premolars the mesial view reveals as much radicular anatomy as a distal view. In molars it is different. In molars a distal view is far preferable to a mesial off-angle view, as the mesial view superimposes the body of the root over the distally curved root structure, while the distal view casts the apical root end sideways, where it can be more easily seen on the radiographic image.

Of course, cone-beam CT (CBCT) imaging is the unfair endodontic imaging advantage. If told I could have either a microscope or a CT machine, but not both, I would choose 3-D imaging every time. Only CBCT imaging can capture the mesial view of root structure—the view in which we see "The Secret Life of Root Canals"—the bucco-lingual plane containing the greatest degree of anatomic complexity. One of the greatest joys of having a CT machine in practice is knowing, for sure, before the access procedure is begun, that there is only a single canal in the mesiobuccal root of an upper molar. Conversely, one of the few negative experiences to be had with this technology is when the reconstructed volume shows two or three canals, in a root that has given up only one to the clinician’s exhaustive search.
The first gift of CBCT imaging to the field of endodontics has been the gift of finding all canals in a given tooth. Its second gift is the great diminution of access size possible, because the access cavity is no longer the primary viewing port into the pulp chamber and beyond. In fact, CT imaging is the only view needed into the anatomic verities of root canal spaces, allowing access cavities to be used exclusively as treatment, rather than as exploratory portals. Ultimately, RCT access procedures will be done with CT-generated drill guides, allowing molars to be treated through three to four 1-mm peaholes, rather than the 2- to 4-mm access cavities used today.

**Outline form**

So what are the objectives we consider when planning the invasion of a root canal space? Basically, all the best access cavities are cut in a balance between conservation and convenience form. We cut as little tooth structure as possible, while ensuring ideal pathways into each canal. Access outline form objectives become fairly simple then; we demand convenience form, otherwise we cannot complete our task, yet we always strive to preserve the structural integrity of the tooth. This boils down to three easily remembered objectives:

1) In anteriors and premolars, conservation form is found in the mesial-to-distal dimension. Traditionally, anterior access cavity outline form has been triangular because of the mesial and distal pulp horns in these teeth—logical until we consider the structural consequences, a needless weakening of coronal tooth structure to insure these lateral pulp horns are cleaned out, when the smallest undercut with a #2 Mueller Bur or Buc-1 ultrasonic tip (Spartan) could suffice as well. Premolars have pulp chambers like the shape of a hand, which is fortunately arranged in a bucco-lingual direction, the angle of the recommended slot-like access cavity outline form is bucco-lingual as well, simultaneously combining convenience and conservation form.

In anterior teeth, convenience form is harder won as the incisal edge is to be avoided, out of respect for postendodontic aesthetic objectives, thus requiring a deeper cut under the cingulum, to allow a more straight-line entry path, while minding the “no-fly zone” of the incisal edge. The most dangerous anterior access cavity error is not cutting adequately through what Dr. Schilder called the “lingual dentinal triangle” under the cingulum, and this can be accomplished with minimal structural weakening when the mesio-distal dimension is kept to a 1 to 1.5 mm width (Fig. 1).

2) In posterior teeth, premolars and molars, it is important to remember that their occlusal surfaces are not centred over the root structure, but are skewed toward the idling cusp side of the root structure. As pulp chambers are centred in the root structure, not centred under the occlusal surface, access in posterior teeth is best accomplished by cutting near working cusps, while staying 1–2 mm away from idling cusps (Fig. 2).

3) In molars, conservation form is held by avoiding the distal half of the occlusal plane, as ideal file paths from the distal canals of upper and lower molars are canted severely to the mesial, so much so that distal canals of lower molars are best referenced to the MB or ML cusp tips, and distobuccal canals of upper molars are best referenced to the palatal cusp tips. Convenience form is achieved by cutting the mesial wall of molar access cavities parallel to the mesial surface of the tooth (Fig. 3).

**Back from the abyss**

I was taught Schilder technique at University of the Pacific by Dr. Michael Scianamblo and after grad school by Dr. Cliff Ruddle. I understood the clinical imperative Dr. Schilder had placed on cutting an access adequate to treat the entire root canal system in a predictable manner, and I enjoyed working through the large access cavities and the generous coronal canal shapes he recommended until I was brought up short by Dr. Carl Reider, a well-known prosthodontic lecturer from Southern California.

When I asked what he most wanted from the endodontists he referred his patients to, he said he wished
we could “just suck the pulp out, without cutting any tooth structure.” As we talked, I came to better understand the structural imperative of saving teeth in the long term, setting me on a quest for tools and methods that would allow us to achieve the same consistently ideal endodontic outcomes, through smaller access openings and coronal canal shapes.

Ultimately, it was the inspiration for my invention of the Maximum Flute Diameter (MFD) limitations on GT and GTX rotary files (DENTSPLY Tulsa Dental Specialties), the LAX (line angle extension) Guided Access Diamond Burs by SybronEndo, as well as obturation methods using flexible condensation devices, such as System-B Continuous Wave electric heat pluggers (SybronEndo) and GT/GTX Obturators (DENTSPLY Tulsa Dental Specialties).

The Itty Bitty Access Committee

Since that initial awakening in the ’80s, it has felt like being a lone voice in the wilderness until the past 10 years, when a new generation of dentists and endodontists, steeped in the new reality of implant dentistry as an alternative to RCT, have taken up the cry for longer-term outcomes through improved structural preservation, ultimately becoming what I jokingly call The Itty Bitty Access Committee (IABC).

As so often happens, somebody outside of our specialty, a general dentist named Dr David Clark, started lecturing on the access elephant in the endodontic living room. He got my buddy Dr John Khademi turned on to the possibilities that more conservative access cavities could offer the specialty, and one by one a group of young endodontists joined the game of who can do a perfect RCT through the smallest access cavity. This ad hoc group of talent began the IBAC club.

The cases shown in Figures 4 through 10—mostly done by IBAC members— make me very happy and afraid at the same time. What the heck are they doing? Little, tiny entries, leaving pulp chamber roofs intact, lateral pulp horns unroofed as well, or just total RCT through previously cut restorative cavities!

After getting over my initial shock at what they were accomplishing, I came to understand that the future of endo is very good in these extremely talented hands, and I saw that the procedure I was developing for endodontic surgery—CT-guided endodontic surgery (CT-GES)—could be applied to conventional treatment as well (Figs. 11a–12d).

And morning breaks over the field of endodontics._

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Figs. 11a–c: From left: Virtual treatment planning for CT-guided endodontic access (CT-GEA). The tooth to be treated is segmented from the CT volume, ideal access entry paths are plotted through the occlusal surface of the tooth, and a CT-GEA drill guide is 3-D printed.

Figs. 12a–d: From left: Author’s root-fractured #18; that tooth set in a stone model after extraction, with the printed CT-GEA drill guide mounted and the first drill in place; the two small access entry holes cut using the drill guide; and a post-exercise radiograph showing cones fit in canals after they were negotiated and shaped.

Figs. 11a Fig. 11b Fig. 11c

Figs. 12a Fig. 12b Fig. 12c Fig. 12d

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**Dr L. Stephen Buchanan, DDS, FACD, FICD,** is a diplomate of the American Board of Endodontics, a fellow of the American and International Colleges of Dentists and serves as part-time faculty to the UCLA and USC graduate endodontic programs. He holds patents on the Endobender Plier (SybronEndo), System-B and Continuous Wave obturation tools and methods (SybronEndo), GT and GTX file systems (DENTSPLY Tulsa Dental Specialties), LA-Axxess Burs (SybronEndo), and Buc ultrasonic tips (Spartan/Otura). Buchanan lives in Santa Barbara, CA, where he enjoys a practice limited to conventional and microsurgical endodontics and dental implant surgery. He is the founder of Dental Education Laboratories, a hands-on training facility in Santa Barbara that he has directed for 28 years.